United States Patent [19]

Beer

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[45] **July 13, 1976**

[54] **MAGNETOSTRICTIVE CLOSURE MEMBER**

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[21] Appl. No.: **500,334**

[52] **U.S. Cl.** **220/260;** 49/34; 49/40; 251/129; 220/213; 220/334; 46/238; 46/239

[51] **Int. Cl.²** **B65D 41/02;** B65D 43/14

[58] **Field of Search** 220/213, 334, 335, 260; 46/238, 239; 251/129; 49/34, 40

[56] **References Cited**

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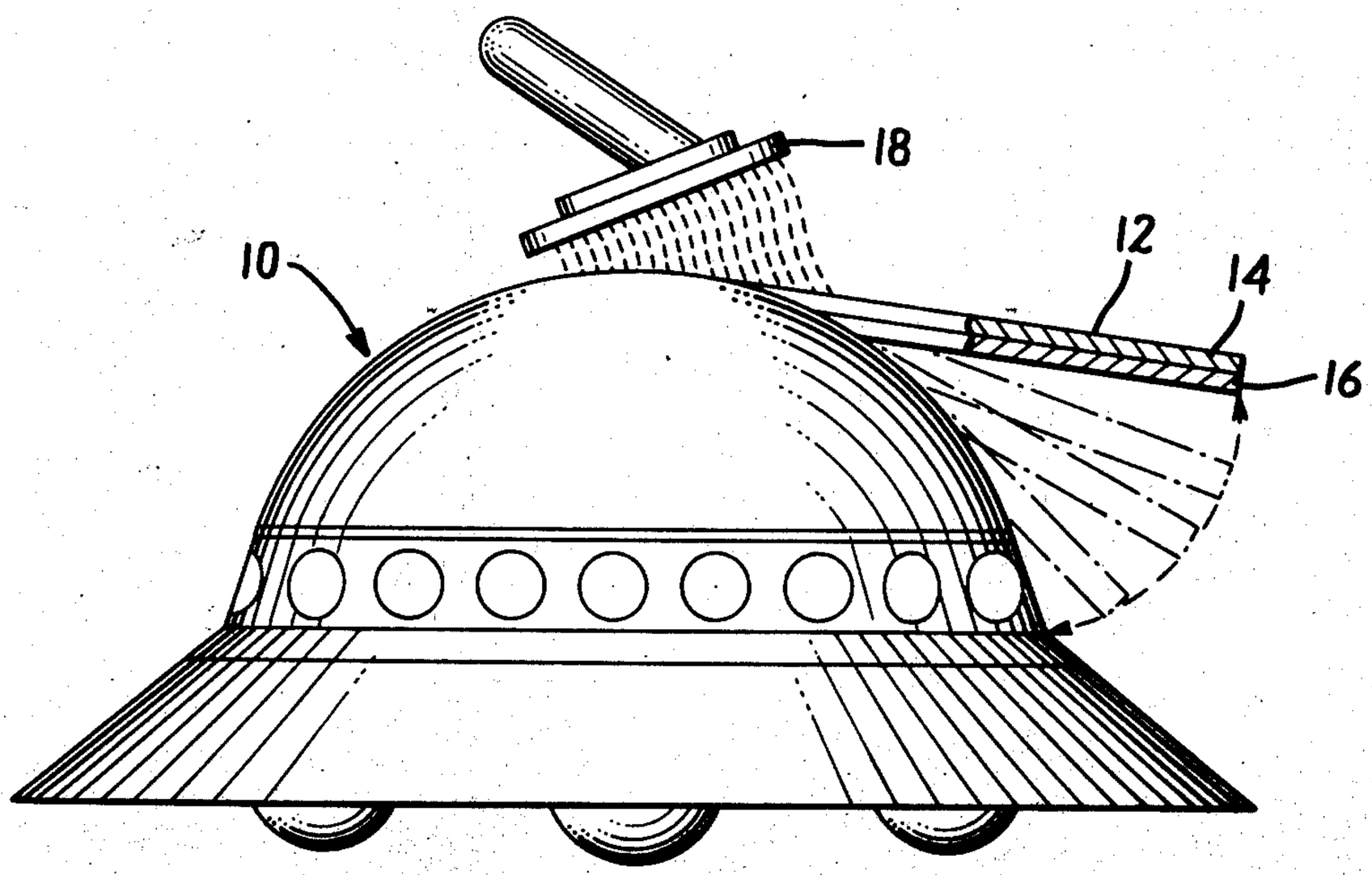
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Primary Examiner—George T. Hall
Attorney, Agent, or Firm—Brumbaugh, Graves, Donohue & Raymond

[57] **ABSTRACT**

A bimetallic closure member comprised of two materials having dissimilar magnetostrictive characteristics does not require a hinge, when subjected to a magnetic field, or alternatively, when removed from a magnetic field, the materials contract or expand at different rates causing the member to bend thereby opening or closing the closure member.

6 Claims, 5 Drawing Figures



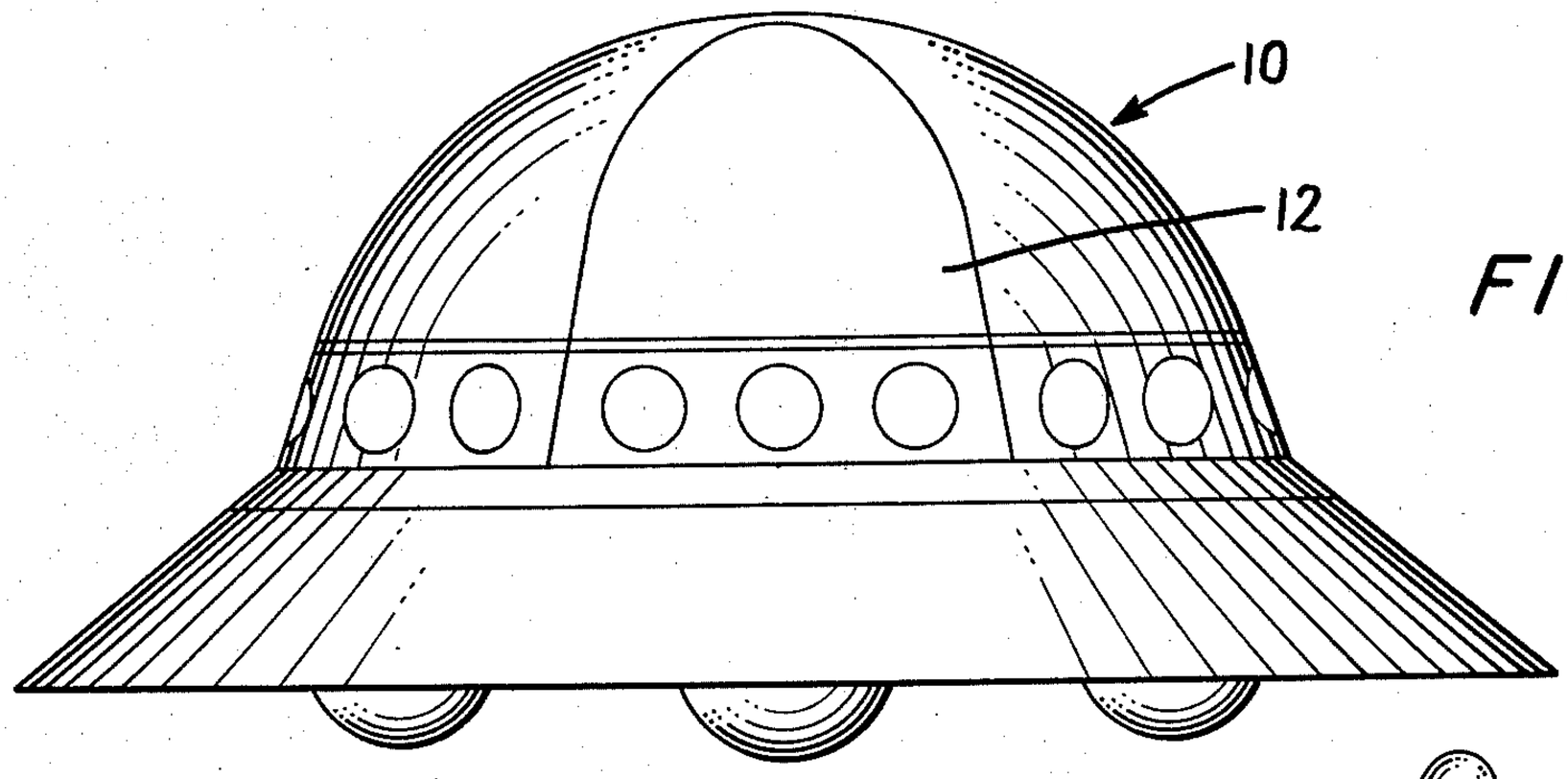


FIG. 1

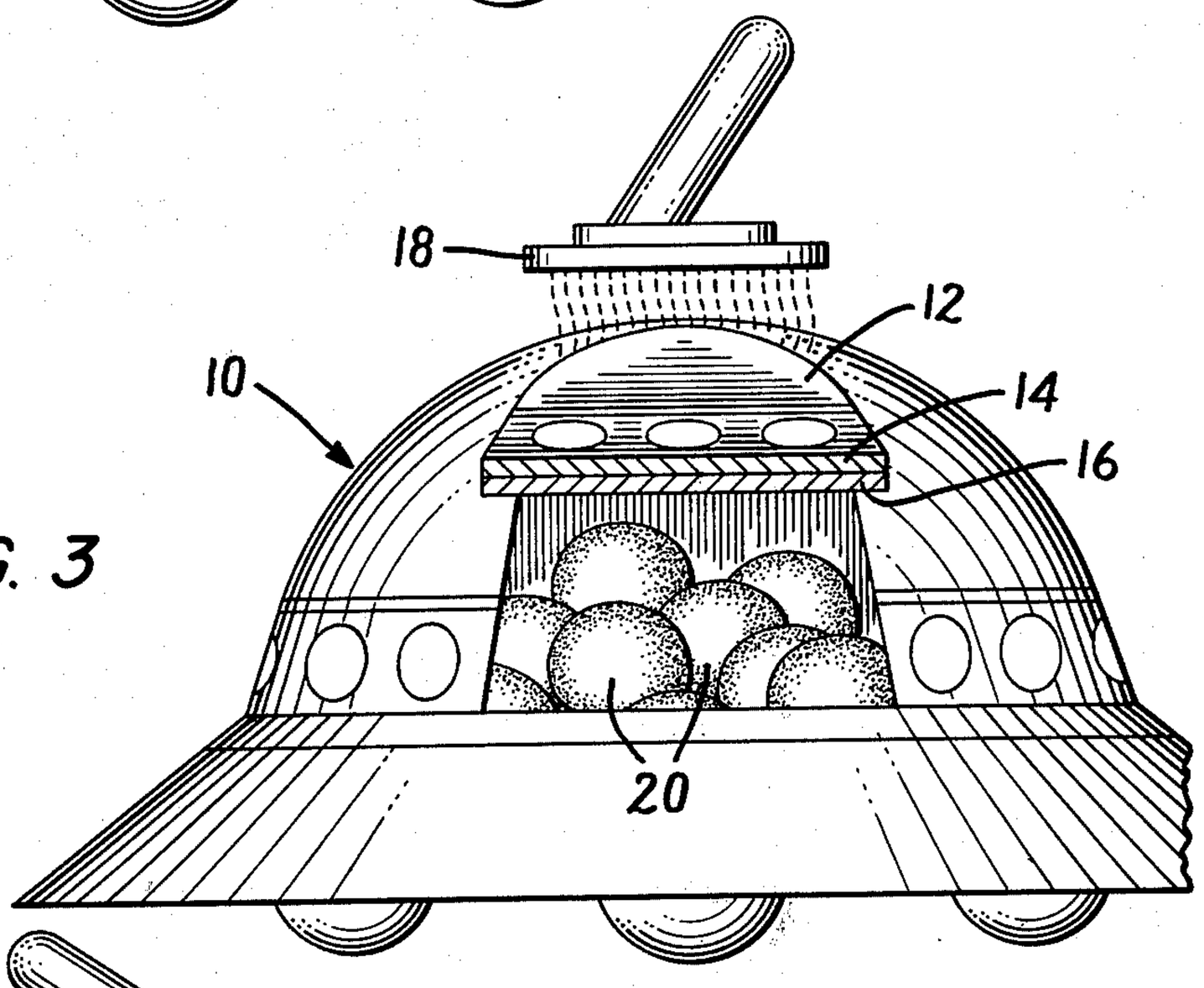


FIG. 3

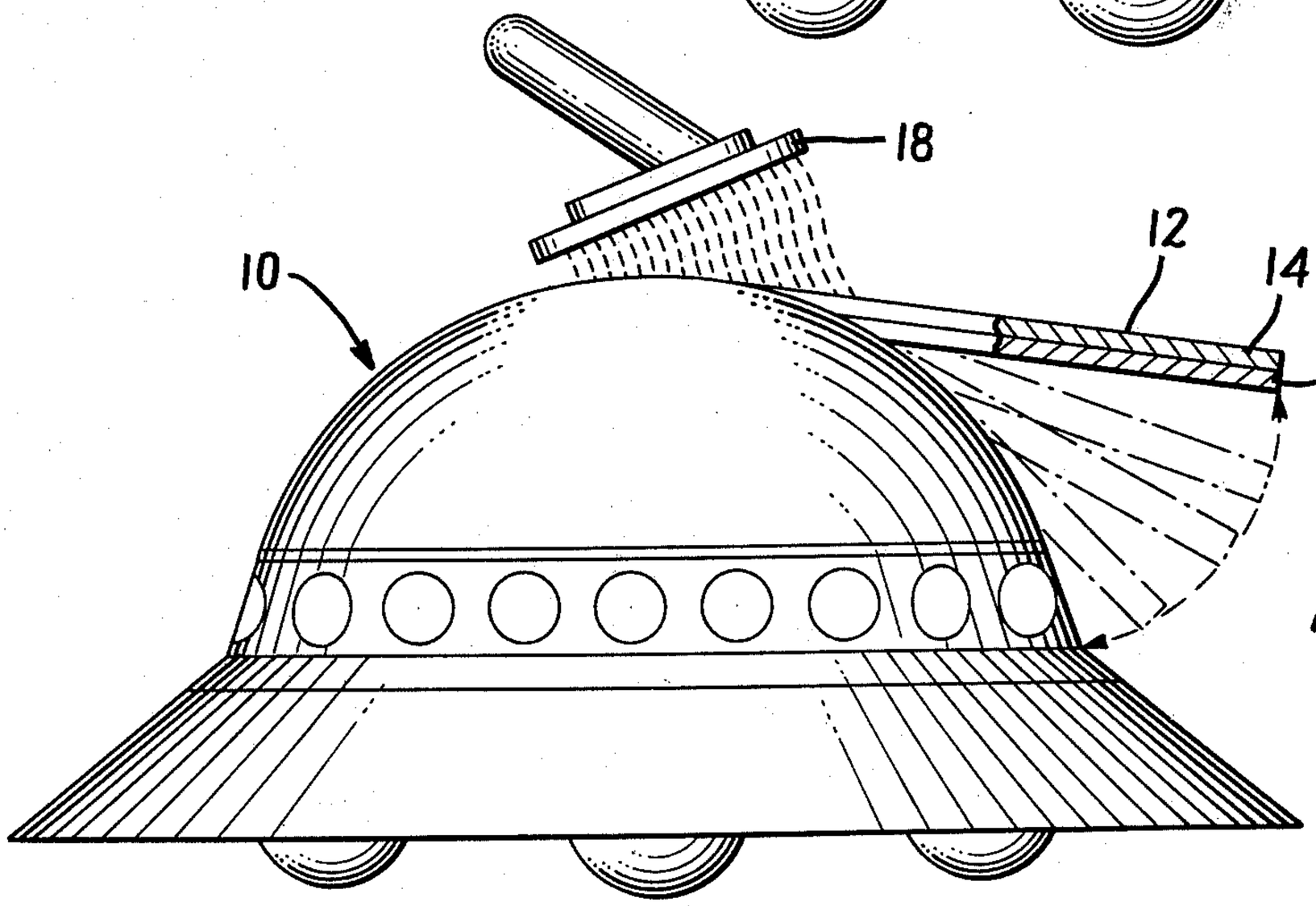


FIG. 2

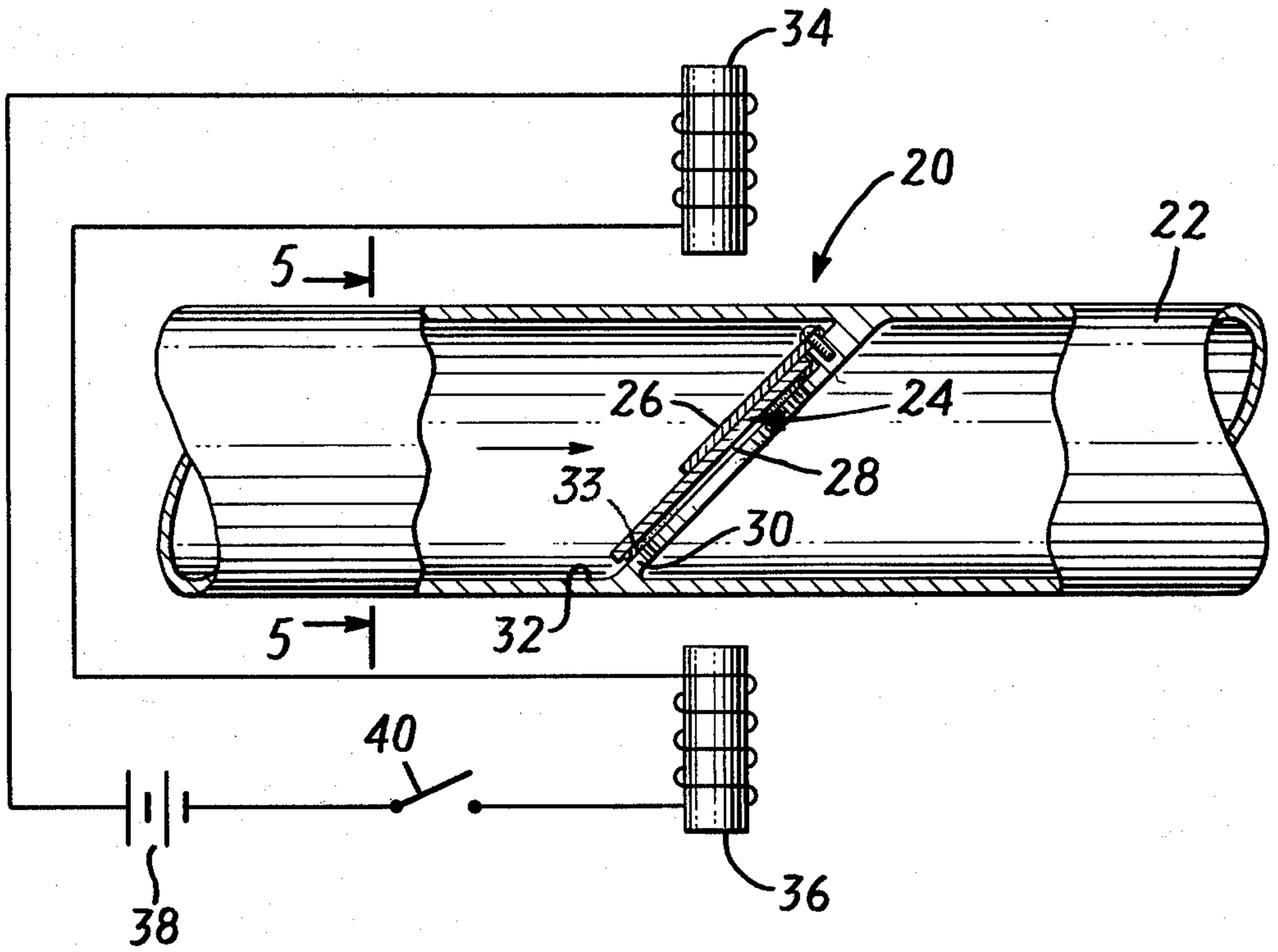


FIG. 4

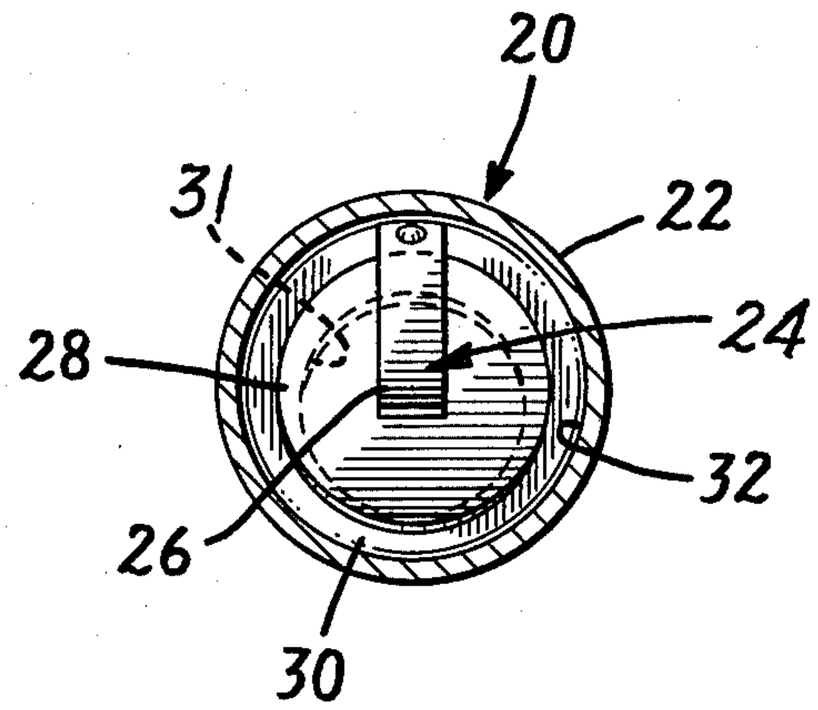


FIG. 5

MAGNETOSTRICTIVE CLOSURE MEMBER

BACKGROUND OF THE INVENTION

Bimetallic thermal strips comprised of two metals having dissimilar thermal expansion rates are well known and are used in various temperature actuated devices such as thermostats and circuit breakers. The principle by which such bimetallic strips operate depends upon the dissimilar rates of thermal expansion of the two materials. The strip bends toward the material having the lower rate of thermal expansion when the strip is heated. Alternatively, the strip bends toward the material having the higher rate of the expansion when the strip is cooled.

Similarly, the principle of magnetostriction relates to the expansion which a magnetostrictive material undergoes when subjected to a magnetic field. Bimetallic magnetostrictive strips operate on a principle similar to bimetallic thermal strips. Bimetallic magnetostrictive strips have been used heretofore and are shown in U.S. Pat. No. 2,475,148 issued on July 5, 1949 to F. Massa for TRANSDUCER MEANS, U.S. Pat. No. 2,764,647 issued on July 25, 1956 to W. G. Leslie et al for a MAGNETOSTRICTIVE RELAY, and in U.S. Pat. No. 3,216,131 issued on Nov. 9, 1965 to J. Singerman for a MAGNETOSTRICTION TEACHING DEVICE. The construction and operation of magnetostrictive strips is further shown and explained in these patents. However, the utility of a magnetostrictive strip as a closure device has not heretofore been recognized.

SUMMARY OF THE INVENTION

In accordance with the invention a magnetostrictive closure member comprises a housing having an opening adapted to receive closure means and closure means adapted to close the opening in the housing. The closure member further comprises a bimetallic magnetostrictive strip which operates the closure means. One end of the magnetostrictive strip is attached to the closure means and the other end of the magnetostrictive strip is attached to the housing.

In some embodiments of the present invention, the magnetostrictive strip may also comprise the closure means.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a front view of a novelty candy container in the form of a "flying saucer" which uses a magnetostrictive closure member in accordance with a first embodiment of the present invention;

FIG. **2** is a front view of the candy container of FIG. **1** with the closure member in its open position;

FIG. **3** is a side view of the candy container of FIG. **2;**

FIG. **4** is a partially cut away sectional view of a second embodiment of the present invention as used in a remotely controlled valve; and

FIG. **5** a front view of the embodiment of FIG. **4.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring generally to FIg. **1,** a container **10** in the form of a "flying saucer" is shown. The container **10** may be made of any suitable material, such as a plastic or a metal, and it includes a magnetostrictive closure member or door **12** made of a strip of two materials having dissimilar magnetostrictive characteristics. The

container **10** may be used as a novelty device to hold candy or similar articles. However, it should be recognized that the magnetostrictive door **12** of the present invention should not be limited as a curiosity device.

Referring generally to FIg. **2,** a side view of the container **10** is shown. The magnetostrictive door **12** is comprised of two metals **14, 16** having different magnetostrictive characteristics. A magnet **18,** which may be either a permanent magnet or an electromagnet, is shown in close proximity to the magnetostrictive door **12.** The magnetic field produced by the magnet **18** acts upon the metals **14, 16** such that the material **16** on the inside portion of the door **12** expands relative to the material **14** on the outside portion of the door **12.** The relative expansion of the inner material **16** with respect to the outer material **14** causes the door **12** to open by bending outward. The opening of the door **12** is not dependent upon the presence of a hinge of any sort, but only upon the relative difference in the expansion rates of the magnetostrictive materials **14, 16** in the presence of a magnetic field.

Referring generally to FIG. **3** a front view of the container **10** with the door **12** in its open position is shown. When the door **12** is bent upward by a field from the magnet **18** the interior of the container **10** is exposed. Articles within the container **10** such as pieces of candy **20** are exposed.

Removal of the magnet **18** from proximity with the door **12** allows the materials **14, 16** to return to their site prior to magnetostriction. In the embodiment of FIGS. **1–3,** the door **12** will close.

Referring generally to FIGS. **4** and **5,** a magnetostrictive valve **20** for remotely controlling fluid flow is shown enclosed in a portion of a sealed pipe **22.** The valve **20** includes a bimetallic magnetostrictive closure member **24** comprised of two materials **26, 28** having different magnetostrictive expansion rates. The valve **20** is further comprised of a housing portion **30** having an opening **31** and connected to the inside wall **32** of the pipe **22.** In a pipe **22** having a circular cross-section, the housing **30** comprises an annular ring extending around and sealed to the interior wall **32** of the pipe **22.** A ring seal **33** is also located on the plate **28** to ensure against leakage through the valve **20.** The housing **30** of the valve **20** is preferrably mounted at an angle to the direction of fluid flow (shown by an arrow in FIG. **4**).

Mounted outside of the pipe **22** and on either side of the valve or closure member **24** are a pair of electromagnets **34, 36.** The electromagnets **34, 36** provide a magnetic field when energized by a voltage supply **38.** A switch **40** is used to interrupt the current flow through the electromagnets **34, 36** to remove the magnetic field from between the electromagnets **34, 36.**

In operation, the valve **20** is normally biased to a closed position and sealed by the ring **32** whereby no fluid flow takes place through the closure member **24.** The closure member **24** is opened by closing the switch **40** to establish a magnetic field between the electromagnets **34, 36.** The magnetostrictive material **28** closest to the closure member **24** has a higher coefficient of magnetostrictive expansion than the magnetostrictive material **26** away from the closure member **24.** A magnetic field between the electromagnets **34, 36** causes the magnetostrictive materials to bend to the broken line position indicated in FIG. **4,** thus moving the closure member **24** away from the housing **30.** Since the closure member **24** is now substantially parallel to the flow of fluid, it provides minimal obstruction to fluid

flow. Thus, the fluid flow within the pipe **22** can be remotely controlled from outside the pipe **22.** The magnetostrictive valve **20** is especially useful in applications where the controlled fluid is of a toxic or corrosive nature.

I claim:

1. A magnetostrictive closure member comprising:

a. a housing having an opening adapted to receive closure means;

b. closure means adapted to open or close the opening in said housing; and

c. a bimetallic magnetostrictive strip adapted to operate said closure means, one metallic component of said bimetallic strip being attached to said closure means and having a magnetostrictive property different from the other metallic component of said bimetallic strip, said other metallic component being attached to said housing, such that the bimetallic strip, when subjected to a change of magnetic field, operates the closure means to open or close the opening.

2. The magnetostrictive closure member of claim **1,** wherein said bimetallic magnetostrictive strip has a predetermined curvature when not subjected to a magnetic field and said curvature changes as it becomes subject to a magnetic field with the curvature being related to the intensity of the magnetic field.

3. A magnetostrictive closure member comprising a housing having an opening adapted to receive closure means, said closure means adapted to close said opening in said housing, and a bimetallic magnetostrictive strip adapted to operate said closure means, one end of said magnetostrictive strip being attached to said closure means and the other end of said magnetostrictive strip being attached to said housing wherein the housing comprises a container used for holding objects and the closure means comprises a door which allows access to the container.

4. The magnetostrictive closure member of claim **1,** further comprising magnetic means for operating said closure member.

5. The magnetostrictive closure member of claim **4,** wherein said magnetic means comprises a permanent magnet.

6. The magnetostrictive closure member of claim **4,** wherein said magnetic means comprises an electromagnet.

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